

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

26 AUG 2004

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Applicant's or agent's file reference RS/sk-16071	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/CH 03/0203	International filing date (day/month/year) 28.03.2003	Priority date (day/month/year) 29.03.2002
International Patent Classification (IPC) or both national classification and IPC H02M3/335		
Applicant DELTA ENERGY SYSTEM AG		



- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

- This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

**CORRECTED
VERSION**

Date of submission of the demand 28.10.2003	Date of completion of this report 27.08.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Marannino, E. Telephone No. +31 70 340-3906 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/CH 03/00203

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*

Description, Pages

1-21 as originally filed
22 received on 16.04.2004 with letter of 16.04.2004

Claims, Numbers

1-17 received on 08.06.2004 with letter of 03.06.2004

Drawings, Sheets

1/22-22/22 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-17
	No: Claims	
Inventive step (IS)	Yes: Claims	1-17
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-17
	No: Claims	

2. Citations and explanations

see separate sheet

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EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/CH 03/00203

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following document:

D1: US-A-5 991 171 (CHENG KIM TUNG) 23 November 1999 (1999-11-23)

The present international patent application relates to an apparatus and a method for providing a control signal for controlling a synchronous rectifier in a power converter supplying power to an electric device.

Novelty

The document D1, which is considered the closest prior art for the present application, discloses

A power converter for supplying an output power to a load, comprising:

- a magnetic storage element (105);
- a switch (104) on a primary side of the magnetic storage element;
- a synchronous rectifier (110) (see column 3, line 45-46) on a secondary side of the magnetic storage element having a switching input, a switching output, and a control input for enabling or disabling said synchronous rectifier from conducting current from said switching input to said switching output;
- a network (NS, 110, 112, 114) wherein said switching input, said switching output, and the load are connected together in a circuit.
- a bias winding (NG) in said circuit for producing a bias voltage.

Therefore claim 1 is new and fulfils the requirements of Article 33(2) PCT.

Inventive step

The problem to be solved by the present invention may be regarded as:
to eliminate the extra current sensor of D1.

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The solution to this problem proposed in claim 1 of the present application is given by the following features:

- 1) the bias voltage is representative of the output power
- 2) a control circuit for (a) determining the rate of change of said bias voltage, (b) characterizing said rate of change, and © controlling said control input as a result of the characterization (b).

Even if the man skilled in art would recognise this well-known problem of avoiding the use of an extra component such as the current sensor to detect the load condition he would not be able to apply to the power converter of D1 both of the two steps:

- 1) modify the transformer of D1 for measuring the output voltage via the bias winding of D1 and
- 2) calculate the rate of change of this bias voltage.

Therefore the man skilled in art would not arrive to the subject-matter of claim 1 without using an inventive activity.

Thus claim 1 is also inventive and fulfils the requirements of Article 33(3) PCT.

Industrial applicability

As already mentioned the power converter of claim 1 finds application as power supply for electric devices, therefore the industrial applicability of claim 1 is beyond any doubts.

Therefore independent claim 1 meets the requirements of Article 33(4) PCT.

The same reasoning applies mutatis mutandis to independent method claim 15 which meet thus the requirements of PCT with respect to novelty, inventive step and industrial applicability (Article 33(2), 33(3), 33(4)).

Since remaining claims are dependent on apparatus claim 1 or method claim 15, they also meet the requirements of the PCT with respect to novelty and inventive step.

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The key waveforms of logic diagram of Figure 12C is presented in Figure 12D. On line 500 is presented the input signal A 514, on line 502 is presented the signal after the delay cell 454. The output signal 518 of the gate 458 is connected to the reset input of 462. The output signal 520 of the gate 456 is enabling the comparator 464 during the time interval δ 416. If the output of 464 is high during 416 then Q output of 462 goes high and Vc(SR2) goes high as well. In the event wherein the output of 464 is not high during 416, then the output Q of 462 is maintained low and the Vc(SR2) skips the rising edge during this cycle.

Figure 9a shows a known switch-mode power converter in a half-bridge topology. The control signals Vc (SR1) and Vc (SR2) for the synchronous rectifiers SR1 and SR2 are determined by the control signals for the primary switches Vc (S1) and Vc (S2). The known power converter requires a current sensor shown on the line to the Load Ro. A comparator compares the sensed in current to a reference current and enables or disables the control signals based on this comparison.

Figure 9b shows a switch-mode power converter in a half-bridge topology according to the present invention. The control signals for the secondary rectifiers SR1 and SR2 are determined by the control signals for the primary switches Vc (S1) and Vc (S2), and by the rate of change of the voltage V_B in the bias winding. As previously described, under conditions when the load R_o is heavy or normal the rate of use of the voltage is such that the control signals for the synchronous rectifiers are enabled. Under conditions of light load R_o, the synchronous rectifiers are disabled.

In another preferred embodiment of the invention, the power converter further comprises a connecting portion for coupling the power input portion to the power output portion, wherein said connecting portion includes an inductor as part of said power output portion, wherein said bias winding is coupled in series with said inductor.

The terms and expressions that have been employed in the foregoing specification are used as terms of description and not of limitation, and are not intended to exclude equivalents of the features shown and described or portions of them. The scope of the invention is defined and limited only by the claims that follow.

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CLAIMS:

1. A power converter for supplying an output power to a load, comprising:

a magnetic storage element;

a switch on a primary side of the magnetic storage element;

a synchronous rectifier on a secondary side of the magnetic storage element having a switching input, a switching output and a control input for enabling or disabling said synchronous rectifier from conducting current from said switching input to said switching output; and

a network wherein said switching input, said switching output and the load are connected together in a circuit;

a bias winding in said circuit for producing a bias voltage representative of the output power;

characterized in that said power converter comprises

a control circuit for

- (a) determining the rate of change of said bias voltage,
- (b) characterizing said rate of change, and
- (c) controlling said control input as a result of the characterization (b).

2. The power converter of claim 1, further comprising a power input portion and a power output portion for providing said output power, wherein said circuit is in said power output portion.

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3. The power converter of claim 2, further comprising a connecting portion for coupling said power input portion to said power output portion, wherein said connecting portion includes an inductor as part of said power output portion, wherein said bias winding is coupled in series with said inductor.

5 4. The power converter of claim 3, wherein said connecting portion includes a transformer having a primary winding as part of said power input portion and a secondary winding which includes said inductor.

10 5. The power converter of claim 1, wherein said control circuit is adapted so that the determination (a) includes comparing said bias voltage at a selected time relative to a selected starting value of said bias voltage, and so that the characterization (b) includes comparing the change in said bias voltage in (a) to a reference.

15 6. The power converter of claim 2, wherein said control circuit is adapted so that the determination (a) includes comparing said bias voltage at a selected time relative to a selected starting value of said bias voltage, and so that the characterization (b) includes comparing the change in said bias voltage in (a) to a reference.

7. The power converter of claim 3, wherein said control circuit is adapted so that the determination (a) includes comparing said bias voltage at a selected time relative to a selected starting value of said bias voltage, and so that the characterization (b) includes comparing the change in said bias voltage in (a) to a reference.

20 8. The power converter of claim 4, wherein said control circuit is adapted so that the determination (a) includes comparing said bias voltage at a selected time relative to a selected starting value of said bias voltage, and so that the characterization (b) includes comparing the change in said bias voltage in (a) to a reference.

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9. The power converter of claim 5, wherein said control circuit is adapted so that the determination (a) includes comparing said bias voltage at a selected time relative to a selected starting value of said bias voltage, and so that the characterization (b) includes comparing the change in said bias voltage in (a) to a reference.

5 10. The power converter of claim 5, wherein said characterization (b) includes determining whether the rate of change is either high or low compared to said reference.

10 11. The power converter of claim 6, wherein said characterization (b) includes determining whether the rate of change is either high or low compared to said reference.

12. The power converter of claim 7, wherein said characterization (b) includes determining whether the rate of change is either high or low compared to said reference.

15 13. The power converter of claim 8, wherein said characterization (b) includes determining whether the rate of change is either high or low compared to said reference.

14. The power converter of claim 9, wherein said characterization (b) includes determining whether the rate of change is either high or low compared to said reference.

20 15. In a power converter, a method for supplying an output power to a load, comprising the steps of:

providing a magnetic storage element;

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providing a power input portion comprising a switch;

providing a power output portion comprising a synchronous rectifier having a switching input, a switching output and a control input for enabling or disabling said synchronous rectifier from conducting current from said switching input to said switching output, and a network wherein said switching input, said switching output and the load are connected together in a circuit;

providing a bias voltage representative of the output power;

characterized in that said method further comprises the steps of

determining the rate of change of said bias voltage;

characterizing said rate of change; and

controlling said control input as a result of said step of characterizing.

16. The method of claim 15, wherein said step of determining includes comparing said bias voltage at a selected time relative to a selected starting value of said bias voltage, and wherein said step of characterizing includes comparing the change in said bias voltage in said step of determining to a reference.

17. The method of claim 16, wherein said step of characterizing includes determining whether the rate of change is either high or low compared to said reference.